BRAYTON

Tables for Estimating Amount and Cost of Materials and Labor for Stone, Brick and Plaster Work

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# TABLES FOR ESTIMATING AMOUNT AND COST OF MATERIALS AND LABOR FOR STONE, BRICK AND PLASTER WORK

BY

LOUIS F. BRAYTON

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THESIS

FOR DEGREE OF BACHELOR OF SCIENCE

IN ARCHITECTURAL ENGINEERING

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COLLEGE OF ENGINEERING

UNIVERSITY OF ILLINOIS

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

Louis Frederick Brayton

ENTITLED Tables for Estimating Amount and Cost of Materials and Labor for Stone, Brick and Plaster Work.

IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE DEGREE

OF Bachelor of Science in Architectural Engineering.

N. Clifford Ricker

HEAD OF DEPARTMENT OF Architecture.

53536

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# Tables for Estimating Amount and Cost of Materials and Labor for Stone, Brick and Plasterwork.

The following thesis is presented by the author for the degree of Bachelor of Science in Architectural Engineering. It is hoped that the method of presentation and the practical data may be useful to architects.

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# Quantities for Brick Walls.

The plate on page 9 gives the brick and labor required in the construction of 100 square feet of brick wall varying from 4 inches to 24 inches, for different sizes of brick, various thickness of joints, several proportions of mortar, different quality of work, various prices of materials and labor, etc. The chart is based on data from Baker's Masonry Construction, Trautwine's Pocket-Book, and contractors notes. One quarter of an inch mortar joint has been included for each

4 inches of wall. Five per cent has been allowed for breakage of bricks. Prices are for material delivered and no allowance has been made for scaffolding or profit.

Directions for using Chart Brick. — To find the number and cost of brick, start with the thickness of the wall to be estimated, (see the upper left hand corner of chart) follow along a vertical line to its intersection with the diagonal line giving the thickness of the joint, then follow the horizontal line to the right to the intersection with the line giving the contents of one brick in

cubic inches, then follow down the vertical line to the horizontal scale giving the number of brick required for 100 superficial feet of wall. Write this number in the proposed bill of materials. Continue down the vertical line to its intersection with the line giving the cost of the brick per thousand, and then follow a horizontal line to the left and read on the vertical scale the cost of the required number of brick.

Labor. — To find the labor required, return to the point on the horizontal scale corresponding to the number

of brick required, and follow a vertical line down to the number of brick a mason will lay in an hour, and from thence follow a horizontal line to the left and read from the vertical scale the number of hours of labor required in laying the wall. One tender will conveniently make mortar and tend two masons; consequently the total price per hour for labor is equal to one half the price paid for the tender plus the price paid for one mason. Thus to find the cost of the above labor, continue the horizontal line to the left from the hours of labor required, to the price

of the mason and tender, and from thence proceed vertically upward and read the amount of the cost of the labor.

The plate on page — gives the mortar - material and cost.

Mortar. — To determine the amount of mortar required, start at the upper - left hand corner with the thickness of the wall; proceed vertically to the diagonal line giving the thickness of the joint to be used, and thence horizontally to the right and read on the vertical scale the amount of mortar.

Sand. — If lime mortar is to be used, continue the horizontal line through the

point on the scale giving the amount of mortar required, to the diagonal line marked "lime", and thence proceed vertically down to the horizontal scale and read the number of cubic yards of sand required; continue the vertical line through the number of yards of sand just found, down to the diagonal line giving the cost of sand per yard, and thence follow a horizontal line to the left and read on the vertical scale the cost of the sand. If cement mortar is to be used, the sand is found in the same way, except the "cement" diagonal is used

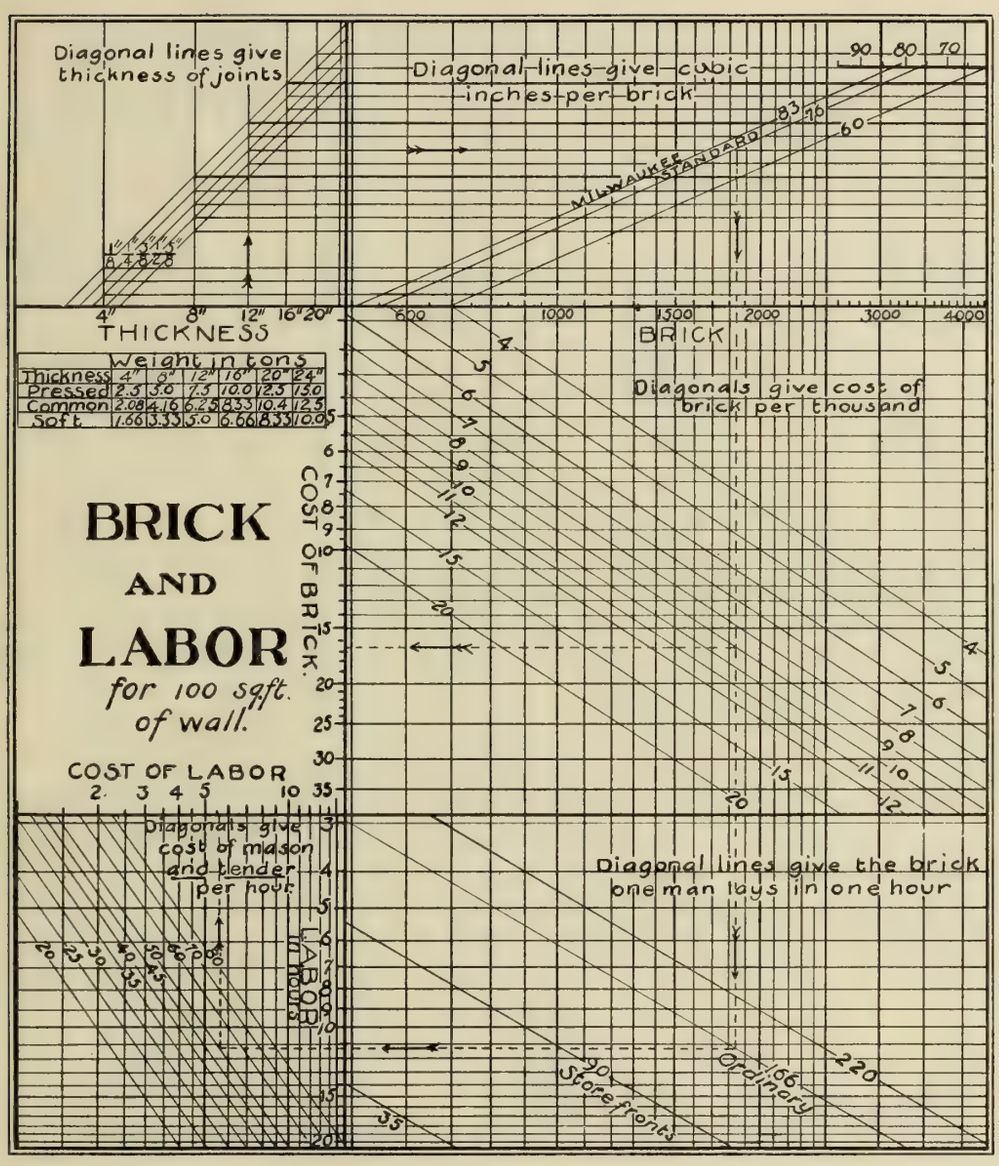
in place of the "lime" diagonal.

<u>Lime</u>. — To determine the amount of lime required, follow the horizontal line from the quantity of mortar required, to the "diagonal for lime", and then proceed in the same way as in determining the amount and cost of the sand.

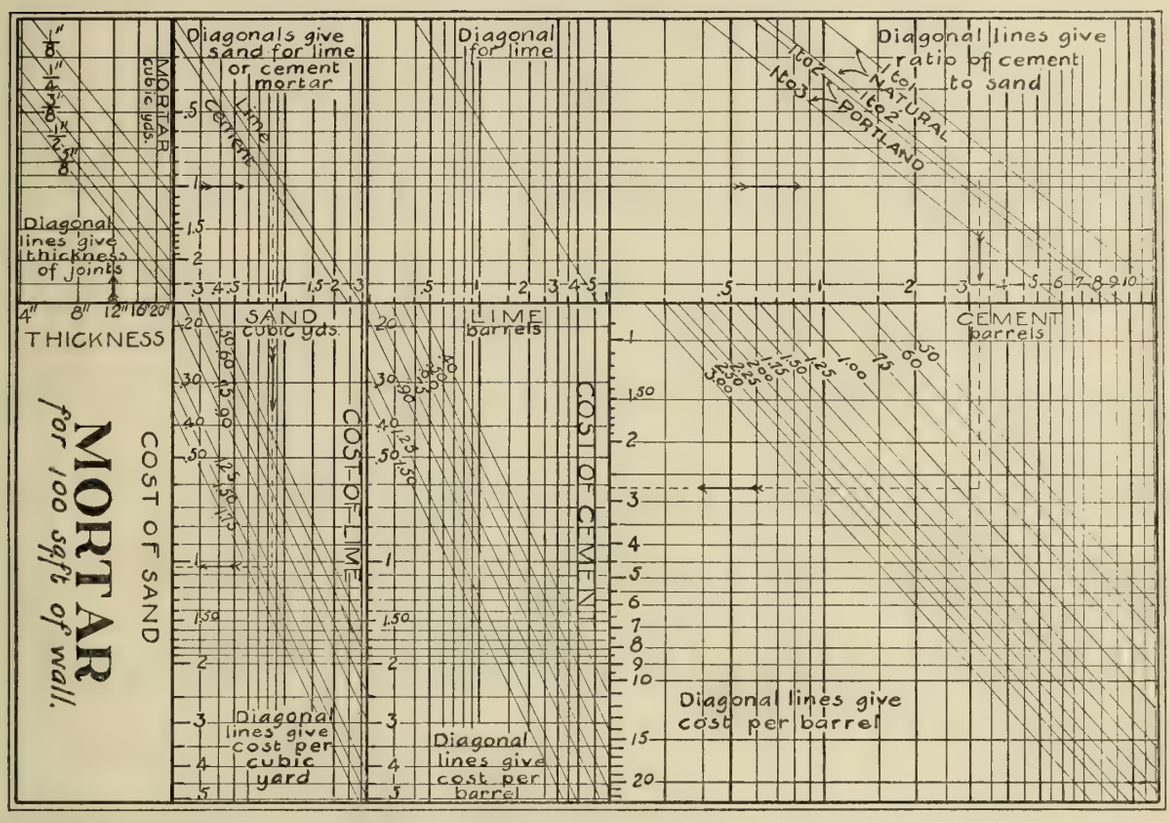
<u>Cement</u>. — To determine the amount and cost of the cement, follow the horizontal line from the amount of mortar required to the right to its intersection with the line giving kind and proportion of cement to be used (at the extreme right hand edge of the chart), and

then proceed in the same way as in determining the quantity and cost of sand.

Weight. – The weight of 100 superficial feet of wall of different thicknesses and different kinds of brick, is given in the small table near the upper left hand corner of the chart on page .
This table is calculated on the basis of pressed brick masonry weighing 150 lbs. per cubic foot, common brick 125 lbs. per cubic foot, and soft brick 100 lbs.




| Weight in tons | | | | | | |
|---|---|---|---|---|---|---|
| Thickness | 4" | 8" | 12" | 16" | 20" | 24" |
| Pressed | 2.5 | 5.0 | 7.5 | 10.0 | 12.5 | 15.0 |
| Common | 2.08 | 4.16 | 6.25 | 8.33 | 10.4 | 12.5 |
| Soft | 1.66 | 3.33 | 5.0 | 6.66 | 8.33 | 10.05 |




Example: Find the materials, labor, cost and weight of an ordinary brick wall 12" thick, laid by 2 masons at 40¢ per hour each, with 1 tender who makes and carries mortar at 20¢ per hour. Standard common brick at $9 per M. Joints 3/8" Mortar of natural cement mixed 1 to 2. Cement 85¢ per bbl. Sand 1.25 per cubic yard. Prices being for materials delivered. 1/4" extra for each 4" of thickness and 5% for waste being allowed. No profit or scaffolding considered

| | | | |
|---|---|---|---|
| Answer | Brick 1850 | | cost $16.60 |
| | Labor | 11.2 hours | 5.60 |
| | Sand | .85 cu.yd. | 1.05 |
| | Cement | 3.3 barrels | 2.75 |
| | Total | | $26.00 |
| | Weight | 6.25 tons | |

Louis F. Brayton

Data for Lath and Plaster.

The table, page , gives the quantities of materials and amount of labor required for different coats of different kinds of plaster with different lath. With this table it is easy to prepare an estimate for any kind of plastering except that involving patent plasters. The data for this table were obtained directly from plastering contractors.

No explanation is needed as to the method of using the table itself, but the following remarks may be useful in this connection. More plaster is required for

metal than for wood lath, because of the heavier clinches and the greater waste; and the greater amount of material requires a corresponding increase in labor. In determining the quantity of material required for plastering on brick, use the data for the brown and white coats, and double the sand in the former, as is explained in the note in the table. In determining the quantities for back plastering, use the data for scratch coat for "drawn" work.

In measuring areas, to determine material and labor, one eighth is added to all circular work and the calculated areas of domes

are doubled. Columns and pillars are measured double whether circular or square; chimney breasts are added to the gross area of the walls. No surface (reveal, chimney breast or panel) is to be considered less than one foot wide. Plasterers at one time measured doors and windows as wall surface, but competition has become so close that it is now customary to deduct them.

Instead of using the table to determine the cost of the labor required for wood lathing, it would better be estimated at from two to two and one half cents per square yard. Metal lath will cost twice as much as wood for labor of putting in place.

# Lath and Plaster.
## Materials and Labor for 100 square yards.

| Coat. | | | | Sand. Cu.yds. | Lime. Barrels | Plaster of Paris | Hair | Plasterer. Hours | Tender. Hours. | Remarks. |
|---|---|---|---|---|---|---|---|---|---|---|
| Scratch | On Expanded Metal | | Drawn | 2/3 | 1 1/3 | | 13# | 6 | 4 | |
| | | | Dry | 2/3 | 1 2/3 | | 15# | 6 | 4 | |
| | On Lath | | Drawn | 1/2 | 1 | | 10# | 3 | 2 | |
| | | | Dry | 1/2 | 1 1/4 | | 12# | 3 | 2 | |
| Brown | Grounds. | 5/8" | Drawn | 1 | 5/9 | | | 7 | 4 | If plastering on brick, double the amount of sand here given and use this for the first coat. |
| | | | Dry | 5/8 | 5/8 | | | 10 | 7 | |
| | | 7/8" | Drawn | 1 1/12 | 2/3 | | | 7 | 4 | |
| | | | Dry | 3/4 | 3/4 | | | 10 | 7 | |
| White | Sandfinish for frescoing | | | 1/4 | 1/4 | | | 9 | 1 1/2 | Frescoe finish used in Champaign Co. court-house. |
| | Putty Finish | | 1 | | 2/3 | 100# | | 9 | 1 1/2 | Putty finishes differ very much. Two good finishes are given here. |
| | | | 2 | | 1 | 50# | | 9 | 1 1/2 | |

| Lath | Lath. nails. | Labor Hours | Labor Metal lath | Furring Strips. | Labor of Furring. | Furring nails. | Remarks. |
|---|---|---|---|---|---|---|---|
| Walls 1400 Ceilings 1500 | 16" Studs. 7# 12" Studs 9# | 7.5 | 18 | 62.5 ft. B.M. | 1/2 to 2 hours. | 13# 8d. or 12# 10d. | Estimates for furring strips are on the basis of 1 1/2" x 1" strips, spaced 16" O.C. |

Louis F. Brayton '01

# Rubble Masonry.

Colonel Culver, a masonry contractor of Springfield, Ill., has kindly furnished the following data on stone work. The tables given, except in form, are exactly as recorded by the foreman on the construction.

## Actual Results in Grafton Rubble Masonry

Basement of Second M. E. Church, Springfield.
Walls 2 ft. to 2 ft. 9 inches, thick.
Footings 3 ft to 3 ft. 9 inches thick.
Total Cubic Contents 4000 feet.

| Item | Quantity | Cost per unit | Total Cost | Cost per cu. ft. of masonry. |
|---|---|---|---|---|
| Stone | | | | |
| at Quarry | 4000 cu. ft. | $1.00 per perch | $182.00 | 4.55¢ |
| Freight | 17 cars | 10.00 " car | 170.00 | 4.25¢ |
| Unloading | " " | 3.00 " " | 51.00 | 1.27¢ |
| Labor | | | | |
| Mason | 503 hours | 20¢ hour | 100.60 | 2.51¢ |
| Helper | 533 " | 14¢ | 74.62 | 1.87¢ |
| Chemist | | | 111.95 | .30¢ |
| Cement | 56⅓ bbl. | $1.05 bbl. | 59.12 | 1.48¢ |
| Sand | 27 cu. yds. | 1.25 yd. | 33.75 | .84¢ |
| Total | | | 683.04 | 17.07¢ |

# Actual Results in Grafton Rubble Masonry

## Basement of First M. E. Church, Beardstown.

## Cubic contents 4700 ft.

| Item | Quantity | Cost per unit | Total Cost | Cost per cu. ft. of masonry. |
|---|---|---|---|---|
| Stone | | | | |
| at Quarry | 4700 cu. ft. | $1.00 per ch | 213.63 | 4.54 ¢ |
| Freight | 587850# | .05 per 100# | 305.93 | 6.50 ¢ |
| Unloading | 216.3 perch | .50 perch | 110.00 | 2.34 ¢ |
| Labor | | | | |
| Mason | 690 hours | 30.2 ¢ hour | 209.76 | 4.45 ¢ |
| Helper | 820 " | 17.4 ¢ " | 142.54 | 3.02 ¢ |
| Chemist | | | | |
| Cement | 87½ bbl. | $1.05 bbl. | 92.15 | 1.96 ¢ |
| Sand | 33 yds. | .40 bbl. | 13.15 | .28 ¢ |
| Total | | | 1087.19 | 23.09 ¢ |

# Grafton Rubble Masonry

## Basement of Millon Block, Springfield.

## Cubic contents 2886 feet.

| Item | Quantity | Cost per unit | Total Cost | Cost per cu. ft. of masonry. |
|---|---|---|---|---|
| Stone | | | | |
| at Quarry | 2886 ft. | $1.00 perch | $131.24 | 4.54 ¢ |
| Freight | " " | 5¢ ft. | 144.30 | 5.00 ¢ |
| Unloading | 11.6 cars | 3.50 car | 39.00 | 1.35 ¢ |
| Labor | | | | |
| Mason | 334½ hours | 23 ¢ hour. | 77.56 | 2.68 ¢ |
| Helper | 321 " | 16½ ¢ " | 52.53 | 1.82 ¢ |
| Cement | 49 bbl. | $1.05 bbl. | 51.45 | 1.78 ¢ |
| Sand | 20⅙ yds. | 1.00 yd. | 20.15 | .69 ¢ |
| Total | | | $516.28 | 17.86 ¢ |

The preceding results seem inconsistant with the data below. However Colonel Culver uses and strongly recommends the following table. It is the result of years of experience

Prices for Grafton Rubble.

| Thickness of wall. | Cost per cubic foot. | Cost per Superficial ft. | Cost per Superficial ft. Range face. |
|---|---|---|---|
| 24" or over | 24¢ | 48 ¢ | 98 |
| 22" | 25 | 45.9 | 95.9 |
| 20" | 26 | 43.4 | 93.4 |
| 18" | 28 | 42. | 92. |
| 16" | 30 | 40. | 90. |
| 14" | 33 | 38.5 | 88.5 |
| 12" | 37 | 37. | 87. |

For above prices all openings are figured solid and all walls are measured from outside to outside at corners. Rubble footings are figured as walls. If dimension stone is used 50¢ per cubic foot pays the

extra cost for cutting and fitting. Prices are for Aug. 15, 1887.

Mr. Chas. Isele of the Peoria Stone and Marble Works contributes the following data on rubble masonry.

110 cu. ft. of rubble will lay 100 ft. wall.
" " " " " will require $1\frac{3}{4}$ yds. mortar.
1 cy. yd. mortar (cement) requires $\frac{3}{4}$ hour labor.
1 " " " (lime) " $\frac{1}{2}$ " " .
Mixing cement mortar by machine saves 20% to 30% of the labor.

# Ashlar Masonry.

Data from Mr. Chas. Stell, Peoria.

100 sq.ft. 4" rockface ashlar will require 50 cu.ft. stone.
" " " 4" sawed " " " $33\frac{1}{3}$ " " " .
" " " 8" rockface " " " 75 " " " .
" " " 8" sawed " " " $66\frac{2}{3}$ " " " .

Coursed ashlar 4", bedding, facing (pitch) & jointing 100 sq.ft., 33 h'rs.
" " " " , rubbing and " " " " 33 " .
" " " " , tooling " " " " 43 " .
Random " " " , pitch facing " " " " 38 " .
" " " " , rubbing " " " " 38 " .
" " " " , tooling " " " " 48 " .
Coursed " 8" " , pitch facing " " " " 36 " .
" " " " , rubbing " " " " 36 " .
" " " " , tooling " " " " 46 " .
Random " " " , pitch facing " " " " 42 " .
" " " " , rubbing " " " " 41 " .
" " " " , tooling " " " " 51 " .
Setting 100 sq.ft. 4" ashlar requires man and helper 9 h'rs.
" " " 8" " " " " " 10 " .
" " 4" " " $\frac{1}{4}$ yard of mortar.
" " 8" " " $\frac{1}{2}$ " " " .
Setting random ashlar requires double above time.
Pointing and cleaning 100 sq.ft. of rubble or tooled - - - - 5 h'rs.
" " " " " " " rock-face - - - - - - - 6 h'rs.

Cutting, tooling and rubbing above is based on Oolitic Limestone or its equal in texture and hardness.

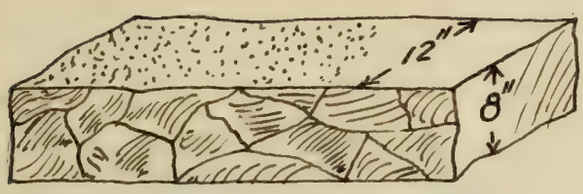
Machine tooling will cost 25% less than hand tooling.

Colonel Culver gives this rule for ashlar: In 9 hours one man will cut ready for setting, 40 ft. (superficial) of Grafton ashlar. According to this 22½ hours would be required to cut 100 superficial feet. On the preceding page it is noted that 33 to 36 hours would be required for 100 ft. I account for this difference by the fact that in the former little care is taken in cutting, there being, as a rule, half inch joints at least. In the latter, the beds are brought to a true surface and joints reduced to ¼ inch. Much more care is taken in the pointing, it

being done after the wall is finished.

## Stone Cutting.

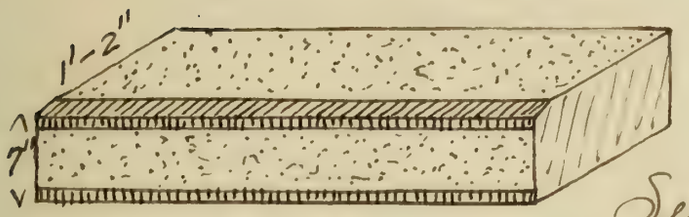
The sketches on the following pages, are taken from Colonel Tudor's field books, and show the time required in the more common forms of stone cutting. These data are averages taken from a very large amount of work. The figures are self explanatory and need no comment.



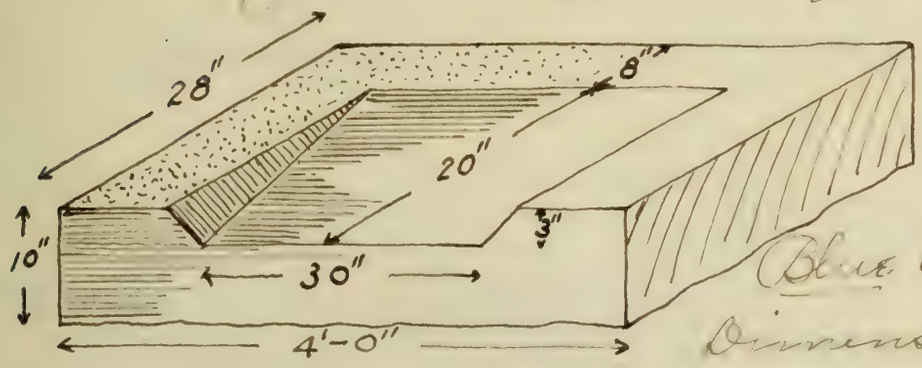

Sill course

Grafton, "B" Grade

Rock faced and Coarse Bushhammered
Average-time 22 min. per lin. ft.

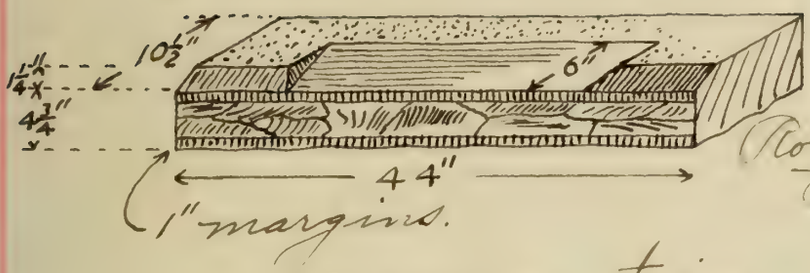



Hard Limestone
Sill Course. No Lugs.
Bush hammered and margined
Droved jointed ends. Rough backs
and bottom beds.
average time per lin. ft. 1h. 8 min.




Blue Amherst.
Dimension Stone.

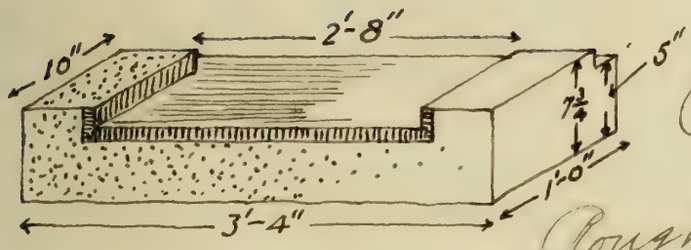
Maximum time 2h. 45 m. each.
Minimum " 2h. 0 m. " .
Average time on 11 sills cut
2h. 24 m. each.




Blue Amherst

Rough Stock, broken to sizes.

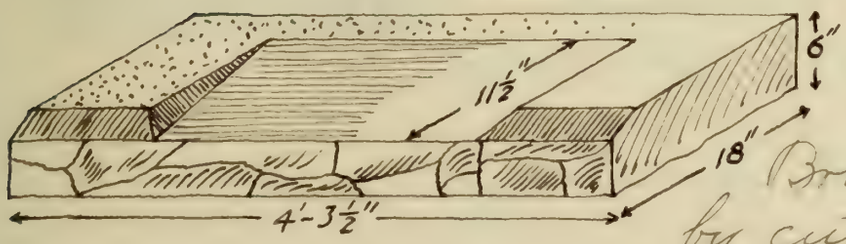
Average time 2 h 23 m. each.




Blue Amherst

Rough Stock, broken to sizes.

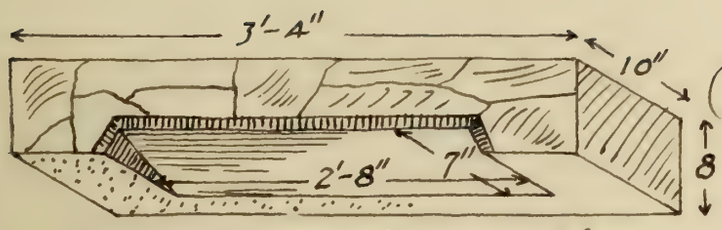
Average time 2 h. 45 m. each.



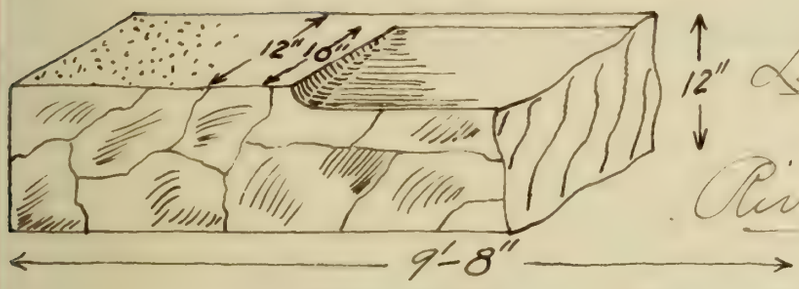

Blue Amherst

Broken to sizes by cutter and included in time of cutting.

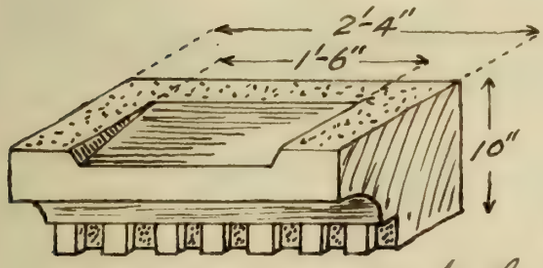
Average time each 2 h. 42 m.



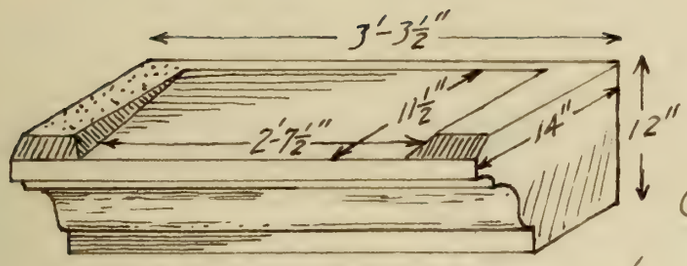

Lintel.
Blue Amherst
Cut from
rough stock broken to size.
average time 2 h. 8 min. each.



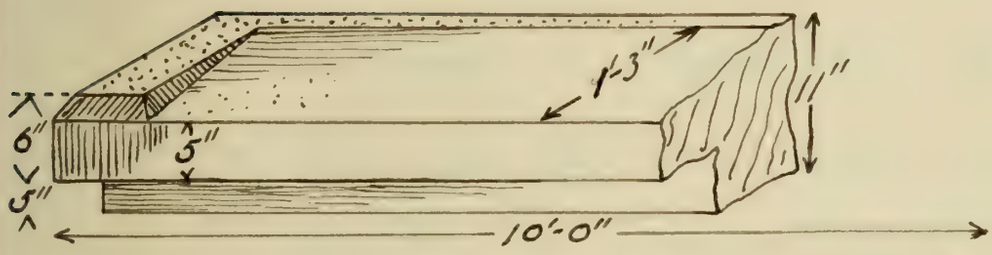

Lug Sills.
Riverside Stone
average time 4 h. 50 m. each.



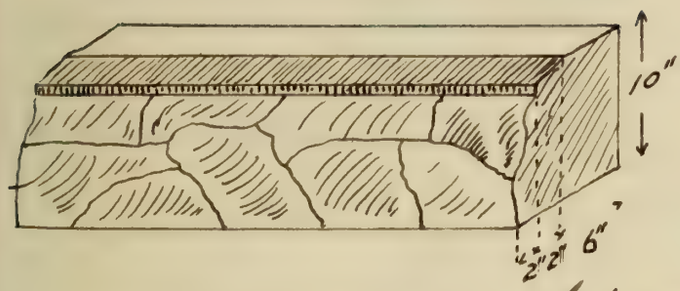

Dentil Sill
Straight tooth chiseled.
cut from Blue Amherst
average time 2 h. 39 m. each.




Story Sills
Cut from
Blue Amherst broken to size.
Average time 6 h. 13 m. each
Closures for same sill 1 h. 50 m. per ft.

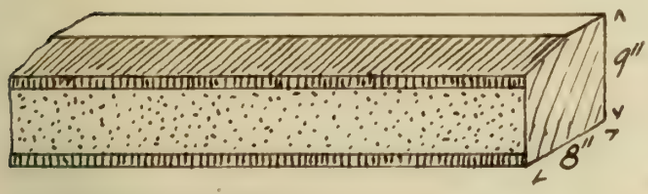



Door Sill. Blue Amherst
dimension blocks broken to size
Maximum time 19 h. 25 m.
Minimum time 16 h. 0 m. each.
Average time 17 h. 15 m. " .
" cost $6.03 " .
Cost is for labor of cutting only.



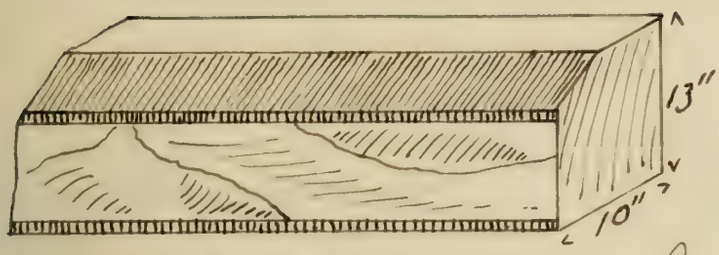

Grafton, Water table.
10" x 10", 2" wash.

Average time 46 m. per. lin. ft.

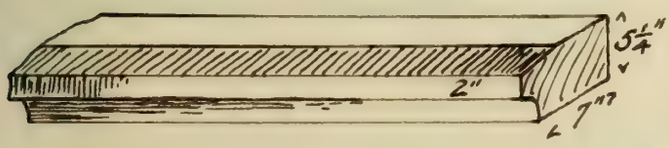



Blue Amherst
Water table.
1" margins and 4" x 1½" wash.
average time 43 m. per. ft.
Cut from rough stock and
broken to sizes.

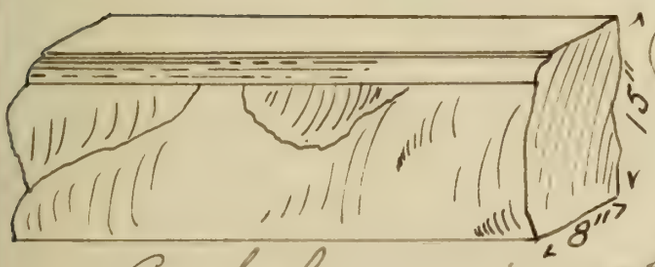
Grafton
Water-table.
Rock faced and tooled wash.
average time 45 m. per ft.



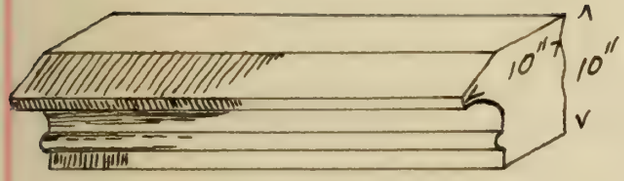

Blue Amherst
Water table
Cut from rough stock, broken to size.
Rock face and 4"x4" wash.
Average time 48 m. per. ft.




Blue Amherst
Water Table.
Cut from rough stock broken to sizes. Nosing and wash tooled. Cove, tooth chiseled. Wash 3"x1".
Average time 51 m. per. ft.

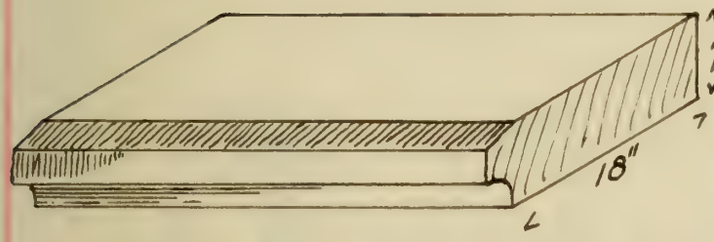



Buff Bedford
Water table.
Coal wash 1½"x1½" tooled.
Cut from rough stock, broken to size.
Average time, 1 h. per ft.



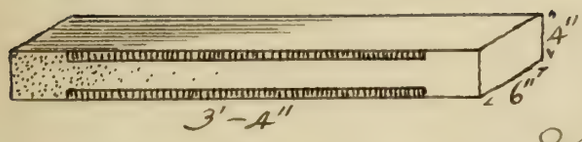

Bedford
Water table.

Average time 2 h. 40 m. per ft.

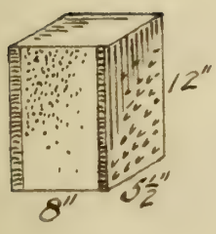



Blue Amherst
Gable Moulded
Coping

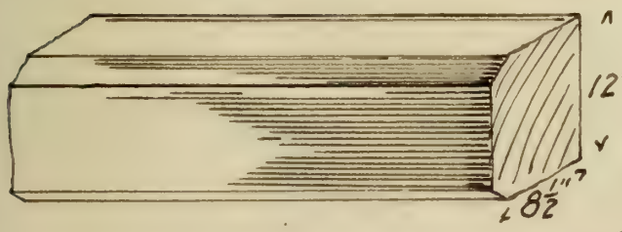
Cut from dimension Stone.
Average time 52 m. per ft.



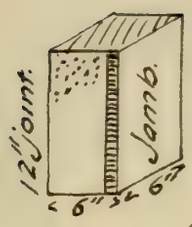

Blue Amherst
Transom Bar
Cut from rough stock, broken to size
Average time 1 h. 17 m. each.



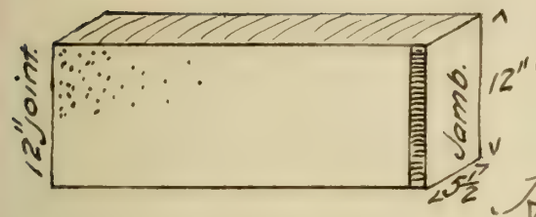

Blue Amherst Mullion.
Cut from rough stock broken to sizes. Faces tooth chiseled, 1" margins.
Average time 1 h. 5 m. each.



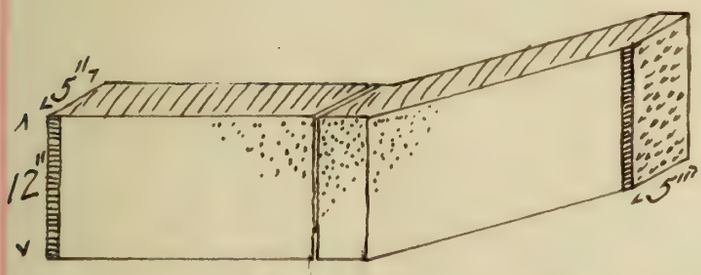

Blue Amherst
Chamfered Tooth chiseled Ashlar.
Average time 35 m. per ft.



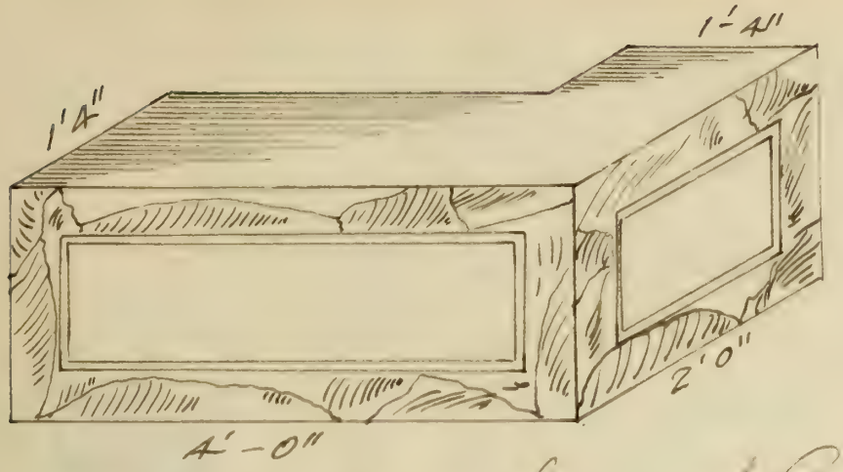

Blue Amherst.
Door jamb cut from stock broken to sizes.
Average time 35 m. each.
" cost 21 ¢ " .




Blue Amherst
Single jamb.
Head one end only.
1" toothed margin
Time 16 m. per ft.

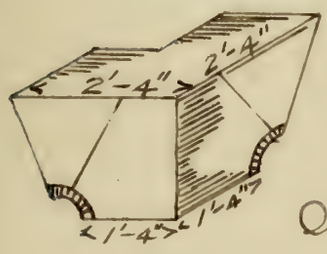



Blue Amherst
Double jambs and 45° corners.
Cut from rough stock broken to size. Heads tooth chiseled.
1" tooled margin.
Average time 30 m. per ft.

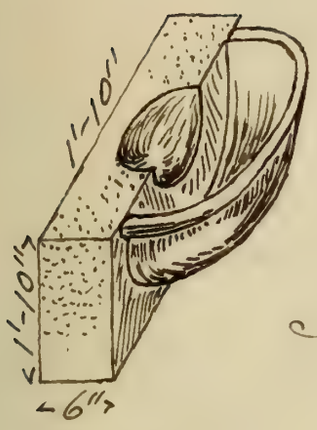



Blue Ambers & Corner Stone
Time 20h. 30m. each.

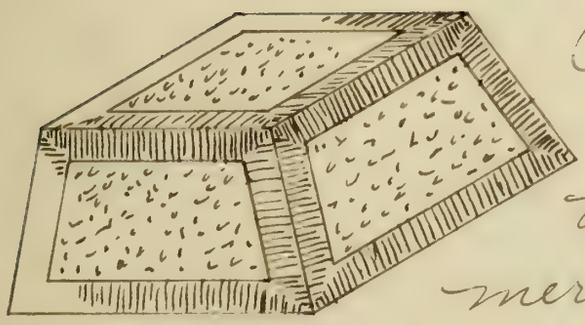
Blue Amber & Porch Lintel
Cut from rough stock broken to size. Above scale is ½ the scale of preceding drawings.
Time 20h. 32m. each.




Blue Ambers & Corner for Porch Lintel
See above. Same scale
Time 8h. 26m. each.

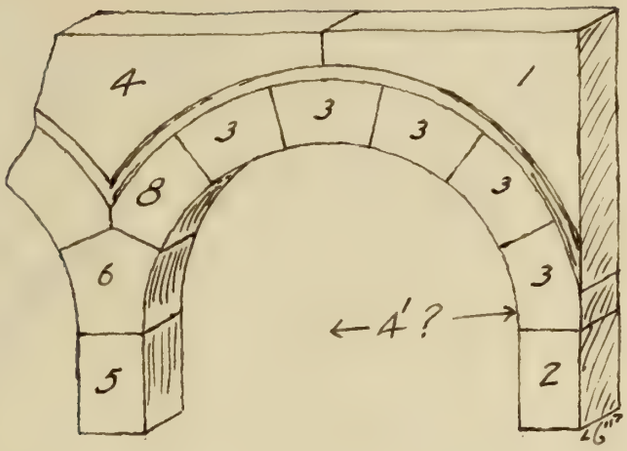



Bedford Stone
Drinking bowl.
Inside radius of
bowl 8"
Outside rad. 9½"
Radius of nich in slab, 4".
Time 15h. rate 35¢.



Bedford Base.
Pointed Beds and
Bevel Grooved.
wash bush-ham-
-mered. Bordered sides.

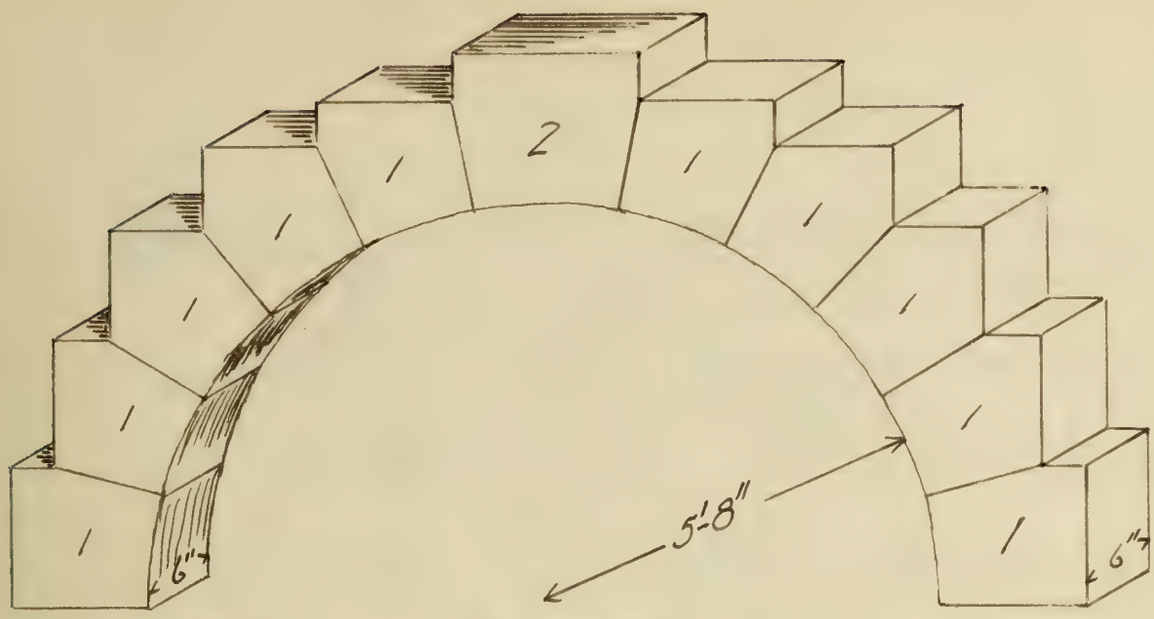
Average time 49m
per superficial ft.



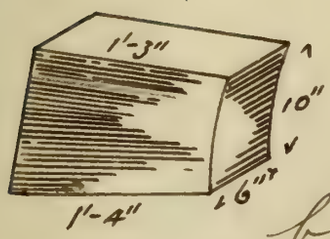

Blue Amherst

arches over windows. Cut from dimension stone broken to size.

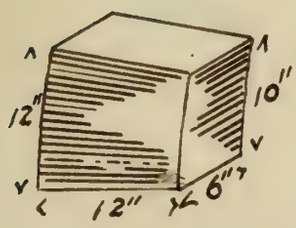
| | Time |
|---|---|
| No 2. | 50 m. each. |
| No 3. | 1 h. 13 m. " . |
| No 5. | 1 h. 6 m. " . |
| No 6. | 1 h. 5 m. " . |
| No 8. | 1 h. 2 m. " . |
| No 1. | 3 h. 50 m. " . |
| No 4. | 4 h. 20 m. " . |



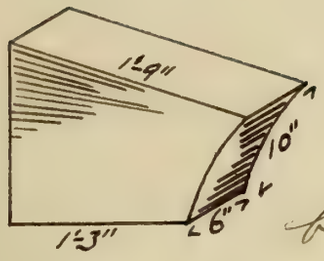

Riverside Stone
Consider all stones alike except keystone No 2
Average time for No. 2 2 h. 20 m. each
" " " No. 1 1 h. 28 m. " .



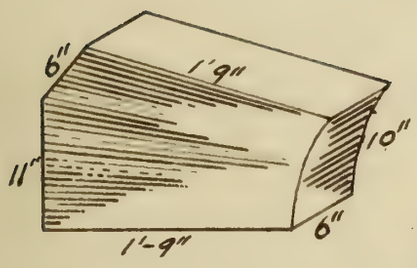

Blue Amherst Voussoir
Cut from rough stock broken to sizes. Faces and soffit, tooth chisled.
Time 1 h. 27 m. each.



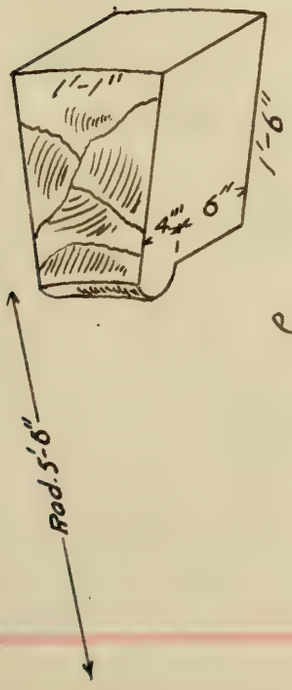

Blue Amherst Voussoir
See just above.
Time 1 h 8 m each.




Blue Amherst Voussoir.
Cut from rough stock broken to sizes. Face and soffit straight tooth chiseled.
Time 1 h. 38 m each.

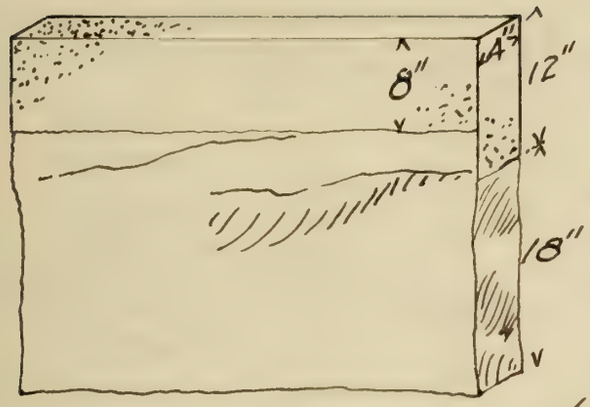



Blue Amherst Voussoir.
See just above.
Time 1 h. 45 m. each.

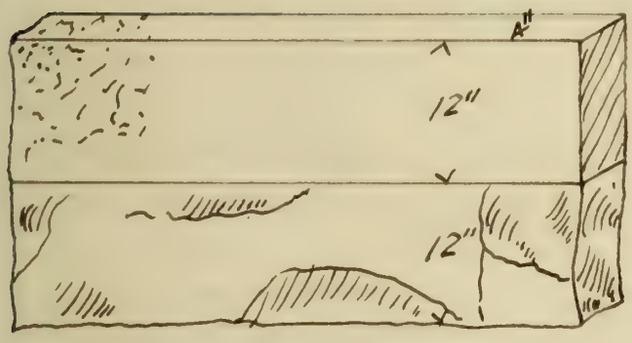



Blue Amherst Voussoir.

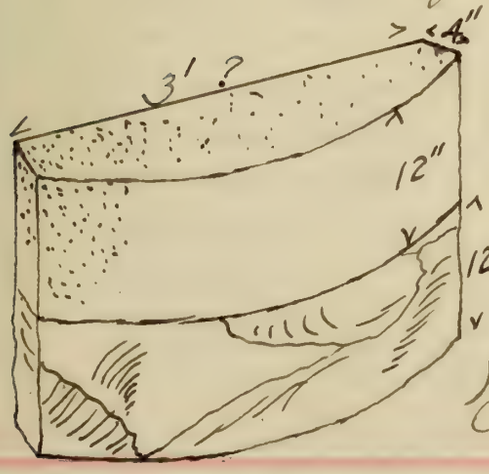
Time 1 h. 0 m. each.




Grafton Curbing
Joints full 12"
down at ends.
3" drafts on back
and top edge.
Average time 28 m. per ft.




Ohio Sandstone
Curbing
Tooth chiseled tops,
face dressed down
1 ft. Backs pointed
4" down. 10.5 ft. per hour or
Average time 5.6 m per ft.




Ohio Sandstone.
Corner for Curbing.
Straight on back.
Radius of front 5'6"
Tooth chiseled on top and
face dressed down 1 ft.
Average time 1 h. 48 m. each

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